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Abstract

REACTOR PHYSICS STUDIES FOR THE STEAM GENERATING HEAVY WATER REACTORS

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The special reactor physics problems arising from the use of a boiling steam-water mixture as the coolant in a pressure tube heavy water moderated reactor are discussed with particular reference to the SGHW prototype reactor now under construction at Winfrith. This reactor concept has led to the development of the 5 neutron-group METHUSELAH code for the assessment of core performance for design purposes, and to the THULE scheme of reactor physics calculation, which makes use of the best physical model of the lattice cell currently available.

The phase of the experimental work described concerns the detailed study of the neutron balance in a range of lattices of the pressure tube heavy water type. The work has concentrated on the study of the void coefficient of reactivity and has required the simulation of light water coolant over a range of densities in unpressurised assemblies. Experimental techniques for characterising events in the fast, resonance and thermal neutron energy regions are described. The high accuracy demanded of these techniques is fixed by the requirement that the void coefficient, which is a differential effect, shall be measured with acceptable

accuracy. In addition to these detailed lattice cell measurements, a range of buckling measurements in lattices with and without light water coolant have been used to provide a check on the void coefficient of reactivity and of the effects of leakage on the neutron balance. The use of two sub-critical assemblies and of the DIMPLE critical reactor for these studies is described.

Particular attention has been given to the comparisons of experimental results with the THULE and METHUSELAH predictions and a method for inferring errors in the theoretical predictions, by deducing a value of the infinite multiplication constant from the detailed lattice cell measurements, is presented.

Detailed comparisons of the experimental results from the range of lattices with the latest THULE and METHUSELAH predictions are given with comments on the accuracy of these methods of calculation for detailed design and reactor assessment purposes.